Reward breaks through the inhibitory region around attents6D6wPeking University, Beijing, China

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It is well known that directing attention to a location in space enhances the processing efficiency of stimuli presented at that location. Research has also shown that around this area of enhanced processing, there is an inhibitory region within which processing of information is suppressed. In this study, we investigated whether a reward-associated stimulus can break through the inhibitory surround. A distractor that was previously associated with high or low reward was presented near the target with a variable distance between them. For low-reward distractors, only the distractor very close to the target caused interference to target processing; for high-reward distractors, both near and relatively far distractors caused interference, demonstrating that task-irrelevant reward-associated stimuli can capture attention even when presented within the inhibitory surround.

Introduction

It is generally assumed that the role of selective attention is to prioritize some stimuli while rejecting others such that the selected stimuli are processed more ef“ciently. The ambiguity resolution theory of attention (Luck, Girelli, McDermott, & Ford, 1997) proposed that multiple objects located in the receptive “eld of the same populations of neurons interact with each other in competing for neural representation in the extrastriate cortex (see also Desimone & Duncan, 1995), causing ambiguity in coding individual objects. To resolve this ambiguity, an inhibition ring is formed surrounding the attended object to suppress distracting objects (Cutzu & Tsotsos, 2003; Hopf et al., 2006; Mounts, 2000b). Mounts (2000a) varied the spatial separation between a shape singleton target and a color singleton distractor in a visual search array and tested how the interference from the distractor was modulated by the distance. Reaction times (RTs) to the target were the slowest when the distractor was adjacent to the target and became faster as the distance between the distractor and the target increased (see also Wei, Lu, Muller, & Zhou, 2008). This effect was taken as evidence for an inhibitory region around the attended object, indicating that distractors located in this region fail to capture attention and cause any interference.

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Attentional capture, i.e., a stimulus involuntarily was followed by •þ10•• in the subsequent feedback frame in 80% of the trials, denoting the receipt of 10 points, and was followed by •þ

1000 ms. No feedback was presented in the test phase. The intertrial interval in both phases was a blank screen of 1000 ms.

In Experiment 1, there were 252 trials for each of the two targets in the learning phase and 40 trials for each condition in the test phase. Experiment 2 had the same number of trials in the learning phase but had 48 trials for each condition in the test phase. Trials were divided into seven blocks in the learning phase and into “ve (for Experiment 1) or six (for Experiment 2) blocks in the test phase. Trials of different conditions were equally distributed in each block and were presented in a pseudorandomized order with the restriction that no more than three consecutive trials required the same responses. Participants were instructed to respond as quickly and accurately as possible to maximize their income. Twenty practice trials in which the monetary feedback was replaced by response feedback (correct vs. incorrect) were provided prior to each of the two phases.

Data analysis

For each experimental condition in the test phrase, omissions, incorrect responses, and trials with RTs6 3 SDs beyond the mean RT for all the correct trials were “rst excluded. Mean RT of the remaining trials (94.0% of all the trials in Experiment 1) in each condition was then computed. The error rate in each condition was calculated as the proportion of the number of omissions and incorrect trials against the total number of trials in the condition (Table 1). For the eye-tracking data in Experiment 2, gaze positions from the onset of “xation to the execution of response were recorded and mean-corrected. For each participant, the mean posi-
t10.9(Exthe)-2d order r32.57(different)-335.9([(feedback.3709 -rror)]TJ 0 -1.1.3(mean)-33A1122 .8(in)-335.3(order)co8l
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Experiment 2

Two-sample Kolmogorov-Simirnov tests comparing the distributions of gaze positions along the vertical and horizontal axes (Figure 3) revealed no difference between the high- and low-reward conditions, both ps . 0.5. Analysis of RTs revealed no main effect of distractor type, F(1, 17)¼2.93, p . 0.1, but a main effect of location, F(2, 34)¼3.41, p , 0.05, and a RTs effect critical distractor interfered with target processing only when it was very close to the target, a pattern consistent with Mounts (2000b) and Cutzu and Tsotsos (2003); in contrast, the distractor associated with high reward interfered with task performance even when it was further away from the target (locations 2…3). This “nding suggests that a reward-associated distractor can break through the inhibitory region surrounding the attentional focus and increase spatial ambiguity in the receptive “eld of the corresponding neurons.

According to the ambiguity resolution theory (Luck et al., 1997), the ambiguity for neural coding is modulated by the number of competitive items within the receptive “eld of the corresponding neurons with more items inducing stronger competition and interference. Consistent with this prediction, Wei et al. (2008) found that the interference between two neighboring targets in visual search was stronger when the set size was large (12 or 20 items) than wheniith

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